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Original Research Article

Comparative Study of Morphological Findings of Placenta of Hypertensive Disorders of Pregnancy with Placenta of Uncomplicated Pregnancy

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Conflict of interest: Nil

Abstract:

Background: Hypertensive disorders of pregnancy are a commonly occurring complication during pregnancy. Placenta is responsible for maintenance of pregnancy and fetal growth. In the present study comparison between morphological changes in placenta of mothers who suffered from hypertensive disorders of pregnancy with the placenta of mothers who had uncomplicated pregnancy was done.

Methodology: Institution based observational, proposed cross sectional study was done at ICARE institute of medical research between February 2021 to August 2022. Study population was mothers who visited the Department of Obstetrics and Gynaecology of IIMSAR & Dr B C Roy Hospital, Haldia. The sample size was 60 among them 30 suffering from hypertensive disorders of pregnancy and 30 were not. Study variables were weight of placenta; feto placental weight ratio; macroscopic and microscopic features; macroscopic and microscopic features of placenta in hypertensive disorders of pregnancy.

Results: The mean weight of the placenta in hypertensive group was significantly lower (439.33±54.93) as compared to normotensive patients (473.93±68.30) and this difference in mean was statistically significant (P value=0.035). Likewise, placental volume in hypertensive group (405.63±46.22) was significantly lower in comparison to normotensive (446.43±57.81) patients (P value= 0.004). Significant lower value for placental area, thickness, diameter, and circumference in hypertensive group compared to normotensive group was found.

Conclusion: Gross examination of placenta in pregnancy induced hypertension (PIH) revealed decrease in mean placental weight, diameter, thickness, numbers of cotyledons and cord length and increased incidence of oval and irregular placentae, marginal insertion of cord, infarction and calcification. On microscopic examination of placenta in pregnancy induced hypertension excessive syncytial knots, increased villous stromal fibrosis, fibrinoid necrosis and basement membrane thickening of the villi were noted.

Keywords: Placenta, Pregnancy, Pregnancy induced hypertension (PIH), Morphology, Morphometric changes.

Introduction

The placenta is defined as a fusion of the fetal membranes to the uterine mucosa for the transfer of oxygen and metabolites between maternal and fetal blood [1]. The placenta performs diversity of functions, ranging from anchoring the fertilized ovum, preventing its rejection by the maternal immune system to enabling the transport of nutrients and wastes between the mother and the embryo/fetus [2]. Trophoblastic invasion usually occurs around 16th week of gestation. Failure of trophoblastic invasion may lead to compromise in feto-placental circulation and results in utero

placental hypoxia. Maternal hypertension is diagnosed in 7% of all deliveries and is associated with 22% of all perinatal deaths and 30% of all maternal deaths [3]. These hypertensive disorders causes decreased placental perfusion due to vasospasm of maternal blood vessels [4]. This study attempts to study the spectrum of morphological changes which can be found in placenta of mothers with hypertensive disorders of pregnancy.

An adequate knowledge of the morphology of the placenta of patients who suffered from hypertensive disorders of pregnancy and its clinical relevance can prove to be valuable in the early assessment of the fetal wellbeing. Hypertensive disorders of pregnancy are a commonly occurring complication during pregnancy. Placenta is responsible for maintenance of pregnancy and fetal growth. In the present study comparison between morphological changes in placenta of mothers who suffered from hypertensive disorders of pregnancy with the placenta of mothers who had uncomplicated pregnancy was done.

Materials & Methods

Institution based observational, proposed cross sectional study was done at ICARE institute of medical research between February 2021 to August 2022. Study population was mothers who visited the Department of Obstetrics and Gynaecology of IIMSAR & Dr B C Roy Hospital, Haldia. The sample size was 60 among them 30 suffering from hypertensive disorders of pregnancy and 30 were not. Patients fulfilling inclusion criteria were included in the study group and those not fulfilling the criteria were excluded from the study group.

Inclusion Criteria:

1. Pregnant ladies aged 18 to 40 years
2. Pregnant ladies with BP >=140/90 mm Hg on 2 occasions measured 6 hours apart and without proteinuria [gestational hypertension/pregnancy induced hypertension (PIH)]
3. Pregnant ladies with BP>=140/90 mm Hg on 2 occasions measured 6 hours apart and with proteinuria (preeclampsia)
4. Pregnant ladies with BP>=140/90 mm Hg at 2 occasions measured 6 hours apart and with proteinuria, complicated with seizures/coma (eclampsia)
5. Deliveries by either vaginal route or caesarean section

Exclusion Criteria:

1. Any other maternal condition which leads to small placental size, placental infarct and intra uterine retardation
2. Pregnant ladies who were diagnosed cases of hypertension before pregnancy
3. Pregnant female who did not give consent for our study
4. Multiple pregnancy (twins, triplets, etc)

Study variables were weight of placenta; feto placental weight ratio; macroscopic and microscopic features; macroscopic and microscopic features of placenta in hypertensive disorders of pregnancy. Written informed consent was obtained from all participating patients. Study group was divided into 2 groups, one comprising of mothers with hypertensive disorders of pregnancy and the other of mothers with uncomplicated pregnancy.

The steps followed for the study of placenta

- Placenta was collected immediately after delivery in 10% formalin solution
- Each placenta along with its cord was coded by a number
- The membranes and cord at their attachment to the placenta were cut off with sharp scissors.
- Gross examination of placenta were done and followings were noted for size, shape, thickness of placenta; surface area and gross appearance of fetal and maternal sides of placenta; marginal veins for any thrombus; number of cotyledons; conditions of membranes; presence of infarction; calcification; site of insertion of umbilical cord and any retro placental hematoma
- Pieces of tissue from the specimen of placenta were taken from the following sites: near the insertion of umbilical cord; margin 12,3,6,9 O' clock positions, centre of placenta; fibrotic area if any; infarcted area if any; umbilical cord at placental junction and cut ends; basement membrane and thickening of villi; part of membrane and any haemorrhagic area

Routine Haematoxylin-Eosin stain and special stains like Periodic Acid Schiff and/or Reticulin stain were done whenever needed. The following features were studied under microscope: number of syncytial knots; cytotrophoblastic cellular proliferation; fibrinoid necrosis; calcified and hyalinised villous areas; obliterated end arteries; decreased villous vascularity; and paucity of vasculosyntitial membrane. Statistical analysis was made using Student's T Test and Chi Square Test. Study proposal and relevant documents was approved by the institutional ethical committee. All data were compiled for interpretation and assessment.

Results

The mean age of the study participants was 31.57 ± 4.48 years with a minimum of 21 years and a maximum of 40 years. Mean age of hypertensive patients was 32.27 ± 5.15 years which was slightly higher than normotensive patients (30.87 ± 3.65 years) (Figure 1).

This difference in mean was not statistically significant (P value= 0.230). Age group wise distribution among both the groups was given in table 1.

Table 1: Age distribution among the study participants

Age group	Hypertensive (N %)	Normotensive (N %)	P value
< 30 years	11 (36.7)	16 (53.3)	0.194
≥ 30 years	19 (63.3)	14 (46.7)	

Morphometry of the placenta: Mean weight of the placenta in hypertensive group was significantly lower (439.33±54.93) compared to normotensive patients (473.93±68.30) and this difference in mean was statistically significant (P value = 0.035). Similarly, placental volume in hypertensive group (405.63±46.22) was significantly lower compared to normotensive (446.43±57.81) mother (P value= 0.004). We found significant lower value for placental area, thickness, diameter and circumference in hypertensive group compared to normotensive group. The details are given in table 2 and figures (2-4).

Table 2: Comparison of gross morphometry of the placenta and cotyledons in both the groups

Placenta	Hypertensive (Mean ±SD)	Normotensive (Mean ± SD)	P value
Weight in gms	439.33± 54.93	473.93± 68.30	0.035
Volume in cc	405.63± 46.22	446.43± 57.81	0.004
Thickness (cm)	1.43 ± 0.36	1.86 ± 0.35	<0.001
Diameter (cm)	14.03 ± 2.21	15.48 ± 2.26	0.015
Circumference (cm)	42.51 ± 7.89	50.51 ± 5.21	<0.001

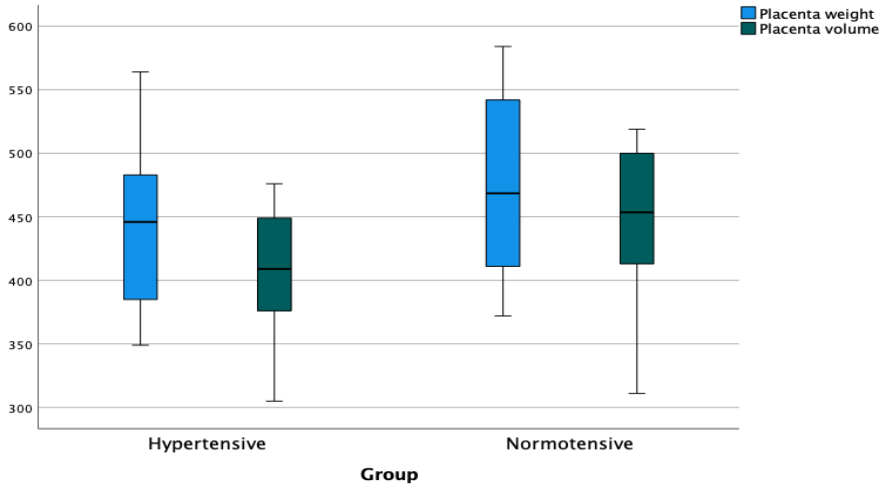

Figure 1: Comparison of placental weight and volume between the groups

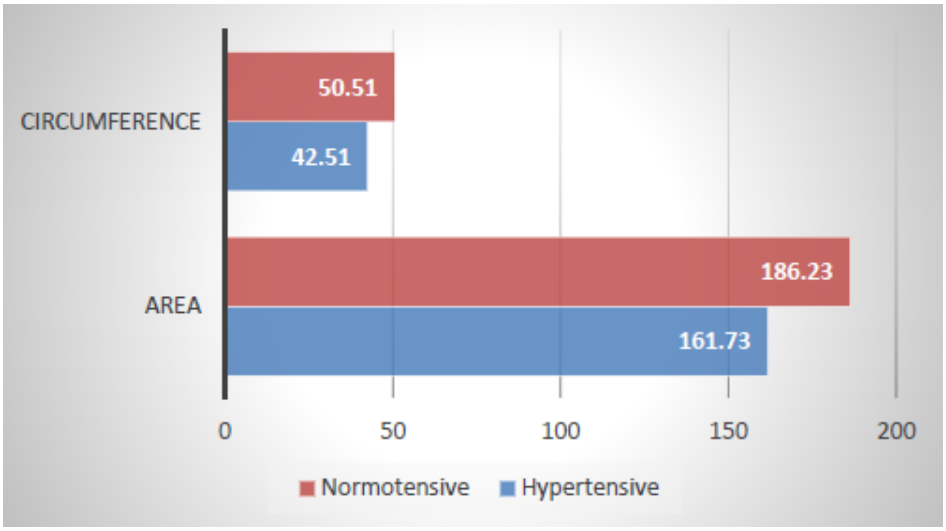

Figure 2: Comparison of placental area and circumference between the groups

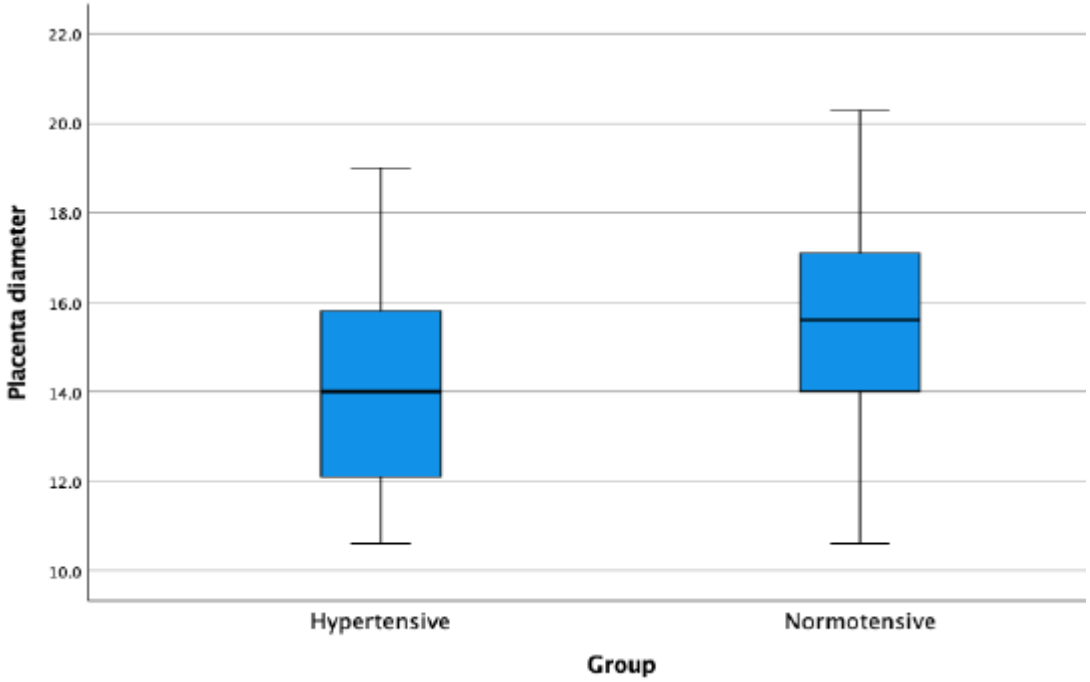

Figure 3: Comparison of placental diameter between the groups

Table 3: Comparison of gross anatomy of the placenta across the groups

Gross anatomy	Hypertensive (Mean ±SD)	Normotensive (Mean ± SD)	P value
Cotyledons			
Average number	16.93 ± 2.18	16.77 ± 1.85	0.751
Marginal insertion			
Present	3 (10.0)	1 (3.3)	0.301
Absent	27 (90.0)	29 (96.7)	
Infarction			
Present	8 (26.7)	2 (6.7)	0.038
Absent	22 (73.3)	28 (93.3)	
Calcification			
Present	4 (13.3)	2 (6.7)	0.389
Absent	26 (86.7)	28 (93.3)	
Retroplacental hematoma			
Present	1 (3.3)	0 (0)	0.313
Absent	29 (96.7)	30 (100)	

Average cotyledons of placenta in hypertensive group (16.93± 2.18) were comparable with that of normotensive group (16.77±1.85) with p value of 0.751.

In 26.7% of the hypertensive patient's infarction was noted, while it was present only in 6.7% of normotensive patient. This difference in proportion was statistically significant (P value= 0.038).

We did not find any statistical significant association of hypertensive disorder with marginal insertion of cord, calcification and Retroplacental hematoma [Table 3].

Table 4: Comparison of villous pathology between the groups

Villous pathology	Hypertensive (Mean ±SD)	Normotensive (Mean ± SD)	P value
Syncytial knot			
Present	9 (30.0)	5 (16.7)	0.222
Absent	21 (70.0)	25 (83.3)	
Fibrinoid necrosis			
Present	9 (30.0)	1 (3.3)	0.006
Absent	21 (70.0)	29 (96.7)	
Acute arthrosis			

Present	8 (26.7)	2 (6.7)	0.038
Absent	22 (73.3)	28 (93.3)	
Hyalinized villi			0.028
Present	10 (33.3)	3 (10.0)	
Absent	20 (66.7)	27 (90.0)	
Cytotrophoblast proliferation			0.006
Present	15 (50.0)	5 (16.7)	
Absent	15 (50.0)	25 (83.3)	

Association of villous pathology with hypertensive disorder was given in table 4 and figures (5-11). While 30% of the hypertensive patients had fibrinoid necrosis, only 3.3% of normotensive patients had fibrinoid necrosis. This difference in proportion was statistically significant (P-value= 0.006). Acute arthrosis, hyalinized villi and cytotrophoblast proliferation were statistically significantly associated with hypertensive disorder [Table 4].

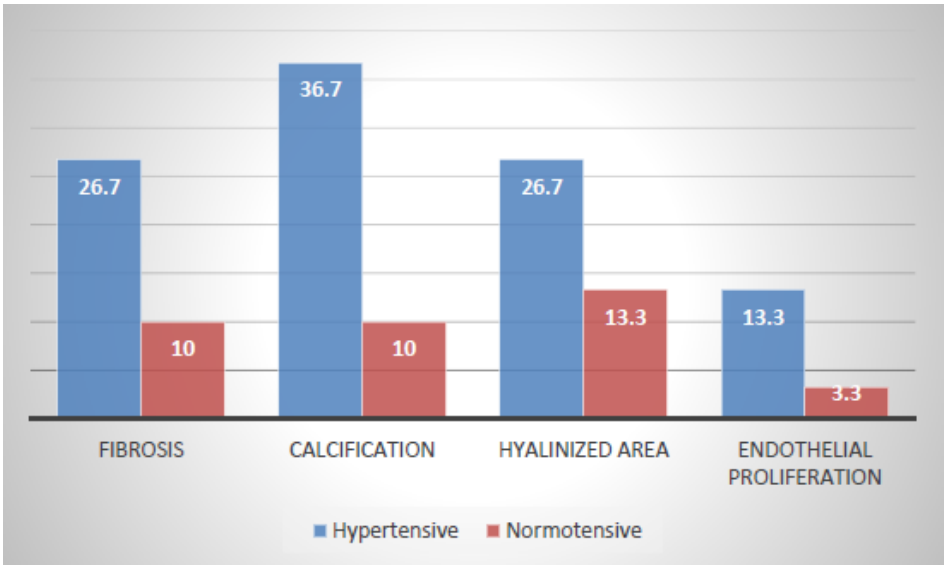

Figure 4: Comparison of stromal pathology between the groups

Association of stromal pathology with hypertensive disorder was given in figure 4. While 36.7% of the hypertensive patients had calcification, only 10% of normotensive patients had calcification. This difference in proportion was statistically significant (P-value = 0.015). We did not find any statistically significant difference for fibrosis, hyalinized area and endothelial proliferation with hypertensive disorder (Figure 4).

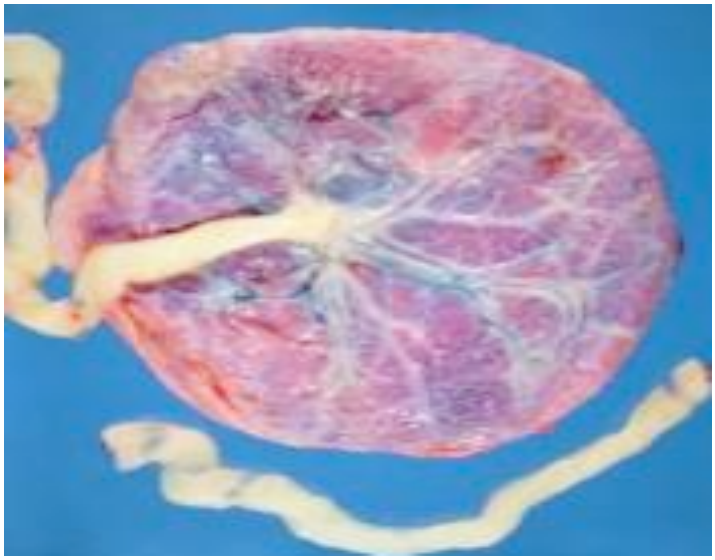

Figure 5: Gross picture of placenta of uncomplicated pregnancy with part of umbilical cord

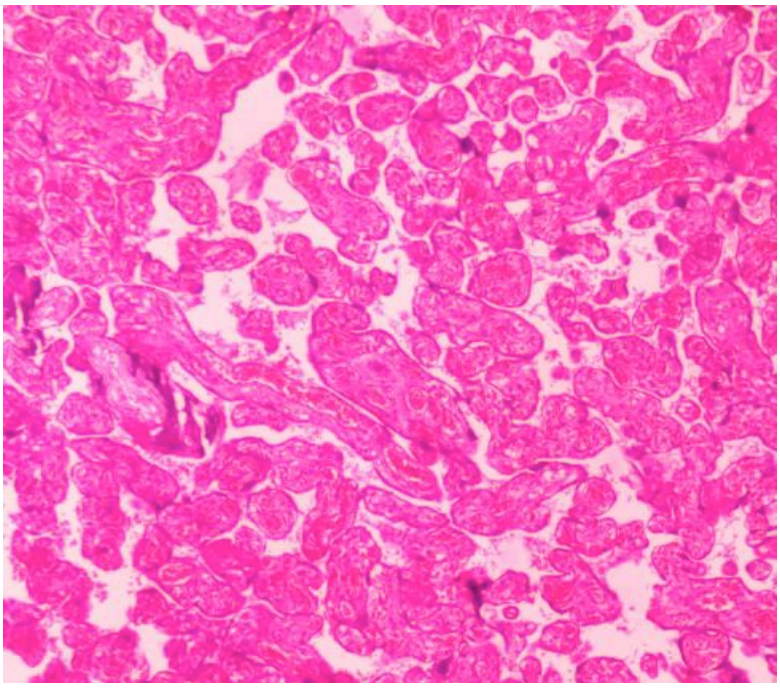

Figure 6: Microphotograph of villi in placenta of mother with placenta of mother with uncomplicated pregnancy (H&E 4X)

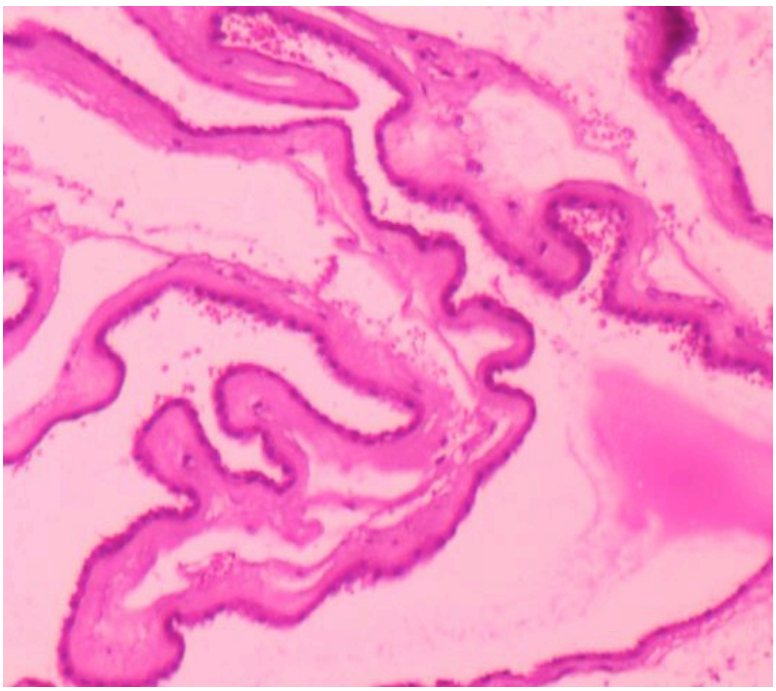

Figure 7: Microphotograph of membranes in placenta of mother with in placenta of mother with uncomplicated pregnancy (H&E 10 X)

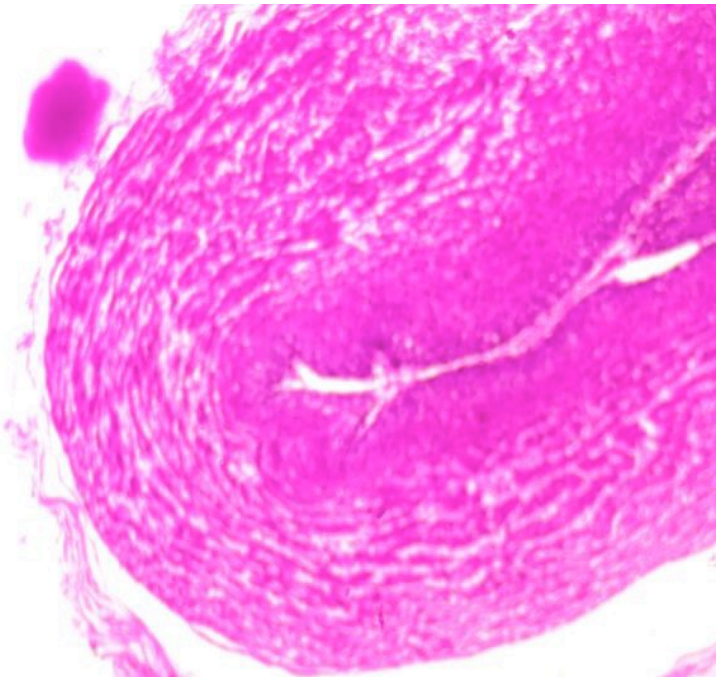

Figure 8: Microphotograph of layers of umbilical artery in placenta of mother umbilical artery in pregnancy of mother with uncomplicated pregnancy (H&E 4X)

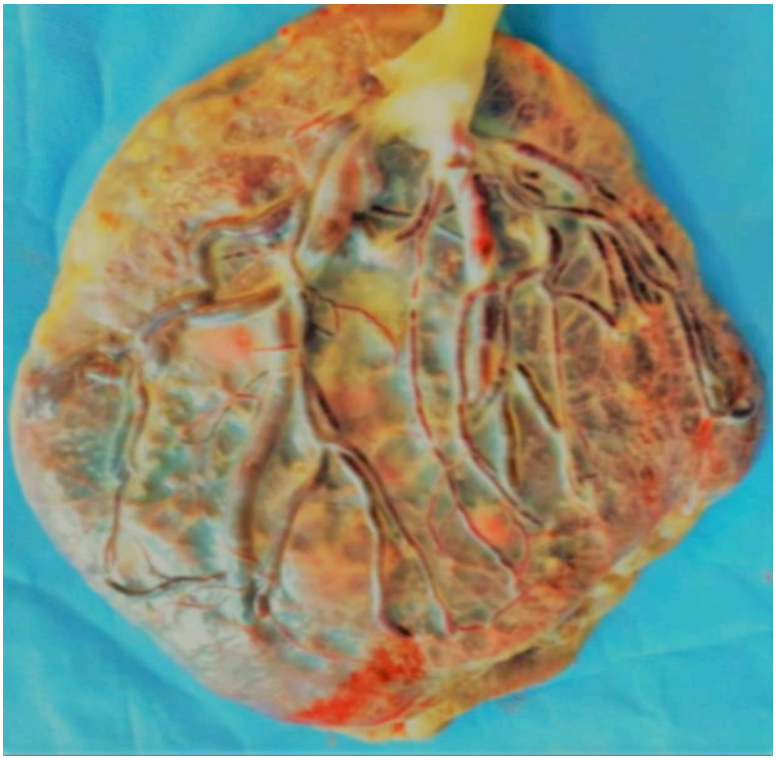

Figure 9: Battle door placenta - marginal insertion of cord

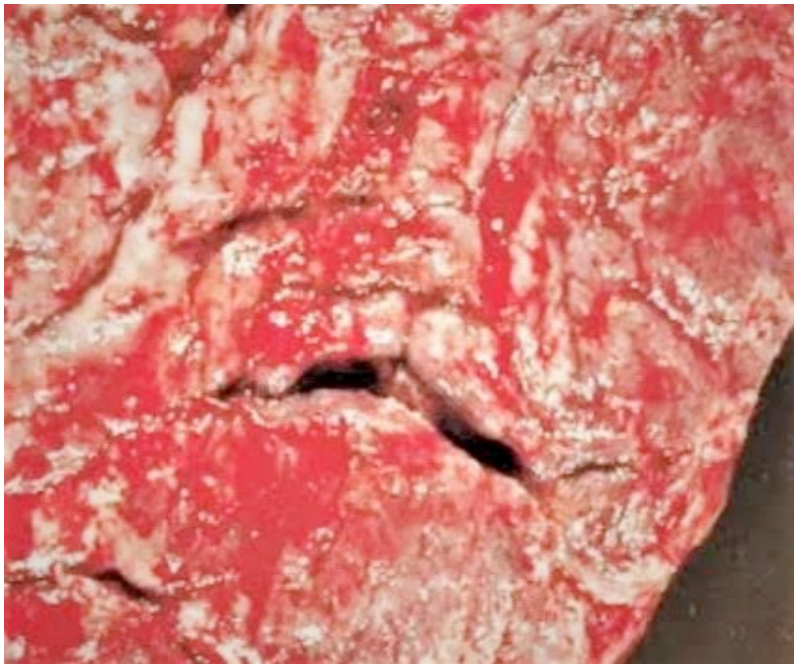

Figure 10: Calcification in placenta

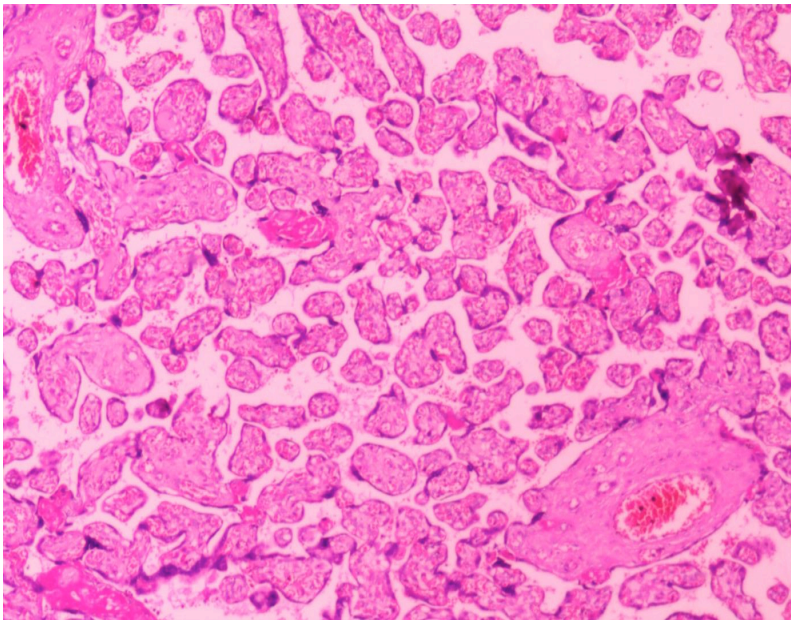

Figure 11: Increased syncytial knots (H&E 10 X)

Discussion

Our study was a comparative study of morphological feature of placenta between pregnancy with hypertensive disorder and uncomplicated pregnancy. We also compared the fetal outcome in relation with the placental characteristics in both the group of patients. We found that the age of both group of patients were comparable (P value > 0.05). Mean weight of the placenta in hypertensive group was significantly lower (439.33±54.93) compared to normotensive patients (473.93±68.30) and this difference in mean was statistically significant (P value= 0.035). Similarly, placental volume in hypertensive group (405.63±46.22) was significantly lower compared to normotensive (446.43 ± 57.81) patients (P value= 0.004). We found significant lower value for placental area, thickness, diameter, and circumference in hypertensive group compared to normotensive group.

Average cotyledons of placenta in hypertensive group (16.93±2.18) were comparable with that of normotensive group (16.77±1.85) with p value of 0.751. In 26.7% of the hypertensive patient's infarction was noted, while it was present only in 6.7% of normotensive patient. This difference in proportion was statistically significant (P value = 0.038). We did not find any statistical significant

association of hypertensive disorder with marginal insertion of cord, calcification and retroplacental hematoma. While 30% of the hypertensive patients had fibrinoid necrosis, only 3.3% of normotensive patients had fibrinoid necrosis. This difference in proportion was statistically significant (P-value= 0.006). Acute arthrosis, hyalinized villi and cytotrophoblast proliferation were statistically significantly associated with hypertensive disorder. While 36.7% of the hypertensive patients had calcification, only 10% of normotensive patients had calcification. This difference in proportion was statistically significant (P-value = 0.015). We did not find any statistically significant difference for fibrosis, hyalinized area and endothelial proliferation with hypertensive disorder.

Study by Kambale T el al, [5] the mean placental weight was significantly higher in the control group (489.1 g) than in the PIH group (405.2 g). They also found that mean placental weight significantly decreased as the severity of disease increased. They reported a mean fetal birth weight in the control group was 2739.7 g, which was significantly higher compared to babies born to mothers with hypertensive disorder (2079.6 gm) and also found that the fetal birth weight decreases with increasing grades of pregnancy induced hypertension. These findings were statistically significant. These finding are similar to our study [5].

These finding was further strengthened by research conducted by Fox et al., [6] who shown that placentae tend to be smaller in preeclampsia than those in uncomplicated pregnancies. It is a well-established fact that blood flow to the placenta is reduced in PIH and this result in a small foetus with poor growth. Fox reported that placentae tend to be smaller in preeclampsia than those in uncomplicated pregnancies [7]. The biological reason of such finding may be due to hypertrophy of placental mass in response to chronic hypoxia in hypertensive cases. This hypertrophy along with low birth weight of foetuses contributes to low fetoplacental weight ratio [7]. Moreover, the preeclamptic women will have a lower mean gestation, so the proportion of fetal capillaries will be lower. The capillaries become larger as the gestation proceeds. This relative increase in fetal capillary volume with decrease in proportion of connective tissue will lead to smaller parenchymal volume leading to decrease in placental weight [8]. Majumdar et al [9] and Kurdukar et al [10] observed that fetal birth weights were lower in cases of preeclampsia; our findings correlated with these studies. The difference in the mean fetal birth weight observed by different researchers may be due to various factors such as socioeconomic status, races, and nutrition of mother. Similar findings were also reported by few of the study in India and elsewhere [11-13].

In the Salmani D et al study [13], the average diameter of placenta in control group was 18.62 cm, in preeclamptic cases it was 17.33 cm, and in case of eclamptic cases it was 16.24 cm. They also found that majority of cases showed eccentric insertion (82%) and few showed central insertion (18%) in both the control and study group [13]. Cibils reported that placenta from PIH cases were smaller than normal indicating an underlying pathological process interfering with the normal growth of placenta [14]. Whereas in the earlier studies by Samadar et al, the pattern of cord insertion was central in 44.19%, eccentric in 42.17%, and battledore in 1.26% [15]. In the Qureshi S et al study, [16] they found the insertion of the umbilical cord as marginal 5% central 7% eccentric 88%. Perry IJ et al [17] reported that in normal birth weight, in 84 .2% cases the mode of umbilical cord insertion was central, 72.7% of cases it was marginal and 90% cases eccentric. These studies supported our study findings.

Studies involving placental villous morphometry have focused on the peripheral (intermediate and terminal) villi, as these villi form the surface for actual materno-fetal exchange. Reductions in placental villous and vascular morphology in pregnancies complicated with PE have also been previously reported [18]. The findings of this study support the hypothesis that, in preeclampsia not associated with severe intrauterine growth retardation, the perinatal morbidity associated with this condition is probably related more too some alterations in uteroplacental and, possibly, umbilical blood flows than to significant changes in placental structure and function. This may be due to compensatory repair mechanisms and extensive functional reserve capacities in these placentas [18]. Fox et al., studied 195 cases of normal placentae out of which 48 (24.6%) showed calcification, and he observed that the incidence of calcification in 6 (6.6%) out of 92 cases was lesser in PIH than in the normal group. He explained that the incidence of calcification in PIH group was lesser than the normal group because he had included cases who delivered before term [6]. Page et al., [19] observed 0.8% and 6.2% retroplacental hematoma in the normal and PIH groups, respectively, whereas Kurdukar et al. noted a percentage of 12% and 12.2% [10]. Thrombotic occlusion of maternal uteroplacental vessels is responsible for infarction [7]. Infarction involving more than 5% of placental parenchyma is clinically significant. Placental ischemia is caused, and a reduced amount of placental tissue is available for nutrition of the foetus causing untoward fetal outcome as suggested by Kurdukar et al. and Fox et al [6, 10]. The results of our study are comparable to the results of study done by Kurdukar et al [10] and Gathiram et al [20].

Conclusion

Gross examination of placenta in pregnancy induced hypertension (PIH) revealed decrease in mean placental weight, diameter, thickness, numbers of cotyledons and cord length and increased incidence of oval and irregular placentae, marginal insertion of cord, infarction and calcification. On microscopic examination of placenta in pregnancy induced hypertension excessive syncytial knots, increased villous stromal fibrosis, fibrinoid necrosis and basement membrane thickening of the villi were noted.

Ethical approval

Ethics approval has been taken from IEC, IIMSAR, Haldia, and West Bengal. Approval no. is IIMSAR, Haldia/IEC/2021/2, dated 13.01.2021.

References

1. Avasthi K, Micha U. histopathology of placenta and its correlation with fetal outcome. J Obstetric Gynaecol Ind 1991; 41:317.
2. Maltepe E, Bakardjiev AI, Fisher SJ. The placenta: transcriptional, epigenetic, and physiological integration during development. J Clin Invest. 2010 Apr; 120(4):1016-25.
3. Fernando Arias. ln: Mosby. Practicalguide to high-risk pregnancy and delivery. 2nd Edition. Harcourt Asia Private Ltd; 2000:184-185.
4. Cunningham F, Leveno K, Bloom S, Hanth J, Rouse D, Spong C. Pregnancy hypertension. ln: Williams Obstetrics. 23rd Ed. New York: McGraw Hill; 2009. 706-756.
5. Kambale T, Iqbal B, Ramraje S, Swaimul K, Salve S. Placental morphology and fetal implications in pregnancies complicated by pregnancy-induced hypertension. Med J Dr DY Patil Univ. 2016 May 1; 9(3):341.
6. Fox H. White infarcts of placenta. BJOG An Int J Obstet Gynaecol. 1963 Dec; 70(6):980–91.
7. Fox H, Elston CW. Pathology of the placenta. 1st ed. Philadelphia: W.B. Saunders; 1978.
8. Ganer Herman H, Barber E, Gasnier R, Gindes L, Bar J, Schreiber L, et al. Placental pathology and neonatal outcome in small for gestational age pregnancies with and without abnormal umbilical artery Doppler flow. Eur J Obstet Gynecol Reprod Biol. 2018 Mar 1; 222:52–6.
9. Majumdar S. Study of placenta in normal and hypertensive pregnancies. J Anat Soc India 2005; 54:34–8.
10. Kurdukar MD, Deshpande NM, Shete SS, Zawar MP. Placenta in PIH. Indian J Pathol Microbiol.2007 Jul; 50(3):493–7.
11. Chakravorty AP. Fetal and placental weight changes in normal pregnancy and pre-eclampsia. BJOG An Int J Obstet Gynaecol. 1967 Apr; 74(2):247–53.
12. Ahmed M, Daver R. Study of placental changes in pregnancy induced hypertension. Int J Reprod Contraception, Obstet Gynecol. 2013; 2(4):524.
13. Salmani D, Purushothaman S, Somashekara S, Gnanagurudasan E, Sumangaladevi K, Harikishan R, et al. Study of structural changes in placenta in pregnancy-induced hypertension. J Nat Sci Biol Med. 2014; 5(2):352.
14. Cibils LA. The placenta and newborn infant in hypertensive conditions. Am J Obstet Gynecol. 1974 Jan 15; 118(2):256–70.
15. Samaddar A, Roy U, Saha I, Mangal S. Histopathological changes in placenta in pregnancy induced hypertensive patients and correlation with fetal outcome – a tertiary care hospital study.Biomed Biotechnol Res J. 2021 Oct1;5(4):440.
16. Qureshi S, Singh J, Fulwaria M, Prakash Yadav O. A study to find out association between morphometry of placenta and neonates profile at tertiary care teaching hospital, Bikaner. Int J Med Sci Educ. 2018; 5(3):359–63.
17. Perry IJ, Beevers DG, Whincup PH, Bareford D. Predictors of ratio of placental weight to fetal weight in multiethnic community. BMJ. 1995 Feb 18; 310(6977):436–9.
18. Teasdale F. Histomorphometry of the human placenta in maternal preeclampsia. Am J Obstet Gynecol. 1985 May; 152(1):25–31.
19. Page EW. On the pathogenesis of pre-eclampsia and eclampsia. J Obstet Gynaecol Br Commonw. 1972 Oct; 79(10):883-94.
20. Gathiram P, Moodley J. Pre-eclampsia: its pathogenesis and pathophysiolgy. Cardiovasc J Afr. 2016 May 18; 27(2):71–8.